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RESEARCH NOTE

THE RELATIONSHIP BETWEEN HEALTH EXPENDITURES AND THE AGE STRUCTURE OF THE POPULATION IN OECD COUNTRIES

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SUMMARY

The purpose of this study was to analyse national health expenditures of OECD countries relative to their age structures. Using econometric techniques designed to analyse cross-sectional time series data, the ageing of the population was found to affect health spending in several countries while having no effect in others. In addition, the effect of income on health spending was lower than that generally reported in the literature. These findings suggest that unobserved country-specific factors play a major role in determining the amount of resources allocated to health services in a country. Such factors also determine if the ageing of the population is associated with increased health spending.

KEY WORDS—health expenditures; ageing; OECD countries

INTRODUCTION

Analysis of variations in health spending between countries and over time improves our understanding of factors that contribute to the growth of health expenditures. This is particularly important as populations age and medical advances exert an upward pressure on spending. A number of studies of the health spending patterns of OECD countries focused on the relation between national health care expenditures and national income.[1–4] The effects on national health spending of sociodemographic income characteristics and health system factors such as the percentage of total spending financed by the public sector, the availability of hospital and physician services, the relative price of health services, and methods of financing physician and hospital services have also been examined.[5–9] Only GDP and the percentage of public sector financing were consistently found to affect health spending. Researchers have not found that the age structure of the population significantly influences per capita national health spending.[5–9] This is surprising in that the populations are ageing, per capita health expenditures for the elderly are higher than expenditures for younger age groups, and in many countries per capita expenditures for the elderly appear to increase at more rapid rates than those of other age groups.[10,11]

The purpose of this study is to analyse national health expenditures of OECD countries relative to their age structures while at the same time examining the effects of national income. Past studies that analysed age structure effects employed single age variables, such as the percentage of the population aged 65 and older. A single age variable measures the correlations between ageing and health spending averaged across all countries. Health and social services, however, are not provided in a uniform manner in the OECD

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countries and these differences could cause the effect of age structure to vary between countries. Such variation could render inconclusive the effects of a single age variable. In this study, country-specific age variables are used to determine the effects of ageing in each country while controlling for changes in income and public sector financing.

METHODOLOGY

The OECD compiles internationally comparable health care information from its member countries, which include Australia, Canada, Japan, New Zealand, Mexico, the United States, and the countries of western Europe. Annual data from 1975 to 1990 for 21 of the OECD member countries were abstracted from the 1992 OECD Health Data File,[12] providing a total of 336 observations.

A fixed-effects (FE) model is employed in the analysis to estimate the effects of per capita GDP, age, and the percentage of health expenditures financed by the public sector on per capita national health spending. Some estimations in this study include a single age variable, the percentage of the population age 65 and older, to determine its ability to explain variations in per capita health spending. Other estimations include country-specific age variables, instead of the single age variable, to assess age structure effects in individual countries. The country-specific age variables are constructed by interacting the age variable with a set of 21 country dummy variables. A logarithmic specification is used for the regressions presented in this paper; however, the results of some linear specifications are also summarized. All data expressed in national currencies were converted into 1985 US dollars using purchasing power parities.

The advantages and disadvantages of using time series and deterministic models for this study were assessed. Owing to the number of years for which data are available and the need to control for unobserved cross-sectional and temporal variation, the temporal data for all countries are pooled and analysed using a deterministic model. Since the cross-sectional and time series data tested positive for autocorrelation and heteroscedasticity, two econometric models, the FE model and the error component (random-effects) model, were considered. Based on the results of a Hausman test, an FE model is used in the analyses except where noted. The FE model includes dummy variables for each cross-sectional unit, except the United States, and each year except 1975. The dummy variables account for relevant explanatory variables not included in the model. Without such a correction, the coefficient estimates of the included explanatory variables may be biased and inefficient. The significance of each set of dummy variables is tested using an F-test. The FE models were first estimated using OLS regression analysis. Tests revealed the presence of autocorrelation and heteroscedasticity in the OLS residuals. For this reason generalized least-squares (GLS) regression analysis is used to estimate the equations presented in this paper.[13]

RESULTS

Three different models are estimated to determine the effects of per capita GDP and age structure on per capita health spending (HTHEXP). First, only the relationship between health spending and GDP is estimated and compared with results from previous studies. The relationship is estimated with and without use of an FE model to determine how the use of the FE model affects the estimated income coefficient. An asterisk indicates significance at the 95% level.

$$\ln \text{HTHEXP} = \underset{(0.43)}{-4.57^*} + \underset{(0.05)}{1.21} \ln \text{GDP}^* \qquad R^2 = 0.68 \tag{1}$$

$$\ln \text{HTHEXP} = \underset{(0.74)}{2.15^*} + \underset{(0.08)}{0.52} \ln \text{GDP}^* \qquad R^2 = 0.97$$
$$+ \sum \beta_i \, \text{time}_i + \sum \beta_j \, \text{country}_j \tag{2}$$

In this and many past studies, per capita GDP appears to explain much of the variation in health expenditures among the OECD countries. The GDP coefficient estimate in Equation (1) is greater than one ($p < 0.01$), and similar in magnitude to those of most previous studies. When the same relationship is estimated using the FE model, the per capita GDP coefficient is less than one and, if the coefficient is interpreted as an income elasticity, indicates that health expenditures are income inelastic. In two previous studies income elasticities are reported to be less than one in certain model specifications.[4,14]

The significance of the time and country dummy variables in Equation (2) indicates that factors other than income are significant in explaining

variations in per capita health spending. Without controlling for these unobserved factors, the relationship between health spending and any excluded variables which are correlated with an included variable, such as GDP, could be captured by the estimated coefficients of the included variables and lead to biased estimates. For this reason, the income coefficient estimated using an FE model in Equation (2) is lower than that of Equation (1).

In the second model, the public sector financing (PCTPUB) and single-age (POP65) variables are also included in the analysis. Table 1 provides a detailed listing of the FE model results.

$$\ln \text{HTHEXP} = \underset{(0.33)}{-3.81^*} + \underset{(0.03)}{1.24} \ln \text{GDP}^* - \underset{(0.05)}{0.30} \ln \text{PCTPUB}^* + \underset{(0.05)}{0.09} \ln \text{POP65}^* \quad (3)$$
$$R^2 = 0.84$$

$$\ln \text{HTHEXP} = \underset{(0.76)}{1.96^*} + \underset{(0.08)}{0.53} \ln \text{GDP}^* - \underset{(0.06)}{0.11} \ln \text{PCTPUB} + \underset{(0.07)}{0.21} \ln \text{POP65}^* + \sum \beta_i \text{time}_i + \sum \beta_j \text{country}_j \quad (4)$$
$$R^2 = 0.97$$

The coefficients for public spending are negative in both equations, yet insignificant in Equation (4). Ageing of the population appears to be positively associated with increases in health spending, yet when the model is estimated using a linear specification the age coefficient is not significant. Given that the Box–Cox results do not clearly indicate that the logarithmic specification is preferable for this model and the age variable is only significant in the logarithmic specification, one cannot conclude that ageing of the population increases per capita health spending.

Under the hypothesis that the effect of age structure on health spending varies between countries, country-specific age variables rather than a single age variable are included in the final model, Equation (5). Based on the significance of the country-specific age variables (as measured by an F-test, ($p < 0.01$)) and the higher R^2, the model with the country-specific age variables appears to fit the data better than the model with the single age variable. When a linear specification is used to estimate the equations, Equation (5) also appears to fit the data better than Equation (4).

$$\ln \text{HTHEXP} = \underset{(0.86)}{3.13^*} + \underset{(0.08)}{0.23} \ln \text{GDP}^* - \underset{(0.05)}{0.18} \ln \text{PCTPUB}^* + \sum \beta_i \text{time}_i + \sum \beta_j \text{country}_j + \sum \beta_j \text{country}_j \times \ln \text{POP65} \quad (5)$$
$$R^2 = 0.99$$

As in the previous equations estimated using FE models, the income coefficient is less than one in Equation (5). Although the magnitudes of the income and public sector financing coefficients are smaller than previously reported in the literature, this is not surprising since they are estimated using an FE model. In Equations (4) and (5), all of the coefficient estimates for the time dummy variables are positive and significant ($p < 0.01$), and the estimated coefficients increase over time. These findings suggest that unobserved factors, whose values increase over time, are associated with increases in health spending in all countries.

The importance of country-specific factors to health spending is demonstrated by the significance of the country dummy variable coefficients. These dummy variables control for factors excluded from the analysis which have the same effect on health spending in a country over time and differ between countries. In Equation (4), all coefficient estimates for the country dummy variables are significant and negative, suggesting that country-specific factors in the United States are associated with higher health expenditures than those in any other country, controlling for the effects of income and public sector financing. In Equation (5), which controls for country-specific age effects, most all country coefficients are estimated to be positive and vary in magnitude and significance.

The country-specific age coefficients measure age effects due to cross-country differences in age structure and within country changes in age structure over time. The country-specific age coefficients in Equation (5) are significant for many countries and vary in magnitude. Seven countries have positive and significant ($p < 0.05$) country-specific age coefficients; the coefficient for the United States is the largest. For eight of the 21 countries included in the analysis the age coefficients are negative ($p < 0.05$) and for six countries the age coefficients are not significant.

The positive relationship between per capita health spending and ageing may be due to increases in the proportion of elderly in the population as well as to increases in their per capita medical expenditures. Although several

Table 1. Analysis of OECD health expenditures per capita, 1975–1990

Independent variables	Equation (3)		Equation (4)		Equation (5)			
	β	Standard error	β	Standard error	β	Standard error	Country-specific age coefficients	
							β	Standard error
Ln GDP	1.24	(0.03)*	0.53	(0.08)*	0.23	(0.08)*		
Ln PCTPUB	−0.30	(0.05)*	−0.11	(0.06)***	−0.18	(0.05)*		
Ln POP65	0.09	(0.04)*	0.21	(0.07)*				
Time variables								
D76			0.02	(0.01)*	0.04	(0.01)*		
D77			0.04	(0.01)*	0.06	(0.01)*		
D78			0.06	(0.01)*	0.10	(0.01)*		
D79			0.07	(0.01)*	0.12	(0.01)*		
D80			0.11	(0.01)*	0.16	(0.01)*		
D81			0.13	(0.01)*	0.19	(0.01)*		
D82			0.15	(0.01)*	0.21	(0.01)*		
D83			0.17	(0.02)*	0.23	(0.02)*		
D84			0.17	(0.02)*	0.24	(0.02)*		
D85			0.18	(0.02)*	0.26	(0.02)*		
D86			0.20	(0.02)*	0.29	(0.02)*		
D87			0.22	(0.02)*	0.32	(0.02)*		
D88			0.23	(0.02)*	0.34	(0.03)*		
D89			0.24	(0.03)*	0.37	(0.03)*		
D90			0.26	(0.03)*	0.40	(0.03)*		
Country								
Australia			−0.29	(0.07)*	3.58	(0.49)*	−0.65	(0.18)*
Austria			−0.38	(0.07)*	0.75	(0.74)	0.50	(0.23)*
Belgium			−0.48	(0.08)*	0.76	(1.66)	0.46	(0.62)
Canada			−0.18	(0.08)*	1.29	(0.43)*	0.42	(0.14)*
Denmark			−0.54	(0.09)*	5.54	(0.42)*	−1.34	(0.13)*
Finland			−0.47	(0.07)*	0.89	(0.59)	0.42	(0.21)**
France			−0.32	(0.08)*	2.62	(0.91)*	−0.18	(0.33)
Germany			−0.27	(0.07)*	2.55	(1.40)***	−0.12	(0.51)
Greece			−1.22	(0.11)*	−1.94	(0.70)*	1.14	(0.29)*
Ireland			−0.57	(0.11)*	11.40	(2.00)*	−4.07	(0.82)*
Italy			−0.52	(0.08)*	−0.08	(0.71)	0.77	(0.25)*
Japan			−0.53	(0.07)*	0.88	(0.43)**	0.42	(0.11)*
Netherlands			−0.32	(0.07)*	4.32	(0.38)*	−0.90	(0.14)*
New Zealand			−0.46	(0.09)*	4.23	(0.54)*	−1.01	(0.21)*
Norway			−0.49	(0.09)*	1.57	(1.07)	0.15	(0.38)
Portugal			−0.90	(0.10)*	1.01	(0.55)***	0.11	(0.18)
Spain			−0.81	(0.09)*	0.76	(0.64)	0.30	(0.23)
Sweden			−0.26	(0.09)*	4.85	(1.24)*	−0.91	(0.44)**
Switzerland			−0.30	(0.06)*	4.53	(0.40)*	−0.86	(0.15)*
United Kingdom			−0.69	(0.08)*	2.21	(0.68)*	−0.16	(0.25)
United States							1.00	(0.14)*
Constant	−3.81	(0.33)*	1.96	(0.76)*			3.13	(0.86)*
R^2	0.84		0.97				0.99	

Data Source: OECD Health Data File, 1992. *,**,*** Significant at the 0.01, 0.05, 0.10 confidence level, respectively. Abbreviations: GDP = gross domestic product per capita; PCTPUB = percentage public expenditures of total health expenditures; D76–D90 = dummy variables for the year indicated; country name = dummy variable for the country; country-specific age coefficient = percentage of population aged 65 and older in the country.

country-specific factors may contribute to the significance of the ageing variables, differences in the delivery and financing of health care could play important roles. Availability and access to new medical and surgical technologies and medically oriented residential facilities are features of a health system that could affect per capita national health spending and per capita spending by certain age groups. For example, a new medical technology or procedure may be used primarily by the elderly and increase per capita health spending for the elderly. Other health system factors, such as differences in the financing of certain health services, could also cause per capita health spending for the elderly to increase more rapidly than that for other ages. To some degree, the estimated country-specific age coefficients may have captured differences in medical care delivery between countries which particularly affect the elderly population because of their high level of medical service utilization.

This study did not include utilization measures of medical technology or other health services. Changes over time in health service utilization or in health care prices are controlled for indirectly by the time dummy variables. Utilization and price differences between countries are controlled for by the country dummy variables.

In order to make inter-country comparisons of country-specific factors that affect health spending, the joint effect of the country dummy variable and the country-specific age variable is calculated. Equation (6) is used to determine the joint effect for each country.

$$\text{JOINT EFFECT} = \text{COUNTRY COEFFICIENT} + (\text{COUNTRY AGE COEFFICIENT} * \ln(12.84)) \quad (6)$$

Only coefficients estimated to be significantly different from zero at the 95% level are included in the calculations. To control for differences in age structure among countries, the joint effect is calculated at the mean percentage of the population 65 years of age and older. For the 21 countries from 1975 to 1990, this mean is 12.84%.

The contribution of the country-specific age coefficient to the joint effect varies across countries. Of the eight countries with the largest joint effects, the United States and Canada are the only two that have significant positive coefficients for the country-specific age variables. These results suggest that the ageing of the population in the United States and Canada contributes to their relatively high level of health spending among OECD countries, controlling for GDP and public sector financing. Although country-specific factors are associated with high levels of spending in the other six countries, higher spending is not associated with ageing of the populations.

CONCLUSION

The results of this study suggest that country-specific factors play an important role in determining per capita health spending when controlling for national income and the public sector financing of health services. The income coefficient, which may be interpreted as an income elasticity, is estimated to be less than one. Although the magnitude for the coefficient is lower than previously reported, this is not surprising in that most other analyses did not control for variations across countries and over time.

Unobserved country-specific factors affect the amount of resources allocated to health services in a country. They also appear to influence how changes in age structure affect health spending. Although populations are ageing and per capita health expenditures for the elderly are higher than expenditures for younger age groups, ageing was not found to affect per capita health spending in previous studies of international variations in health spending. In this study, the influence of age structure on health spending is found to vary across countries. The age structure of the population significantly affects health spending in some countries, with the magnitude of the effect varying among countries. For other countries, age structure does not appear to influence health spending. Less aggregated data can be used to acquire further understanding of factors that lead to variations in the effects of ageing on per capita health spending.

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